CENTER *for* BIOLOGICAL DIVERSITY

THE JOHN MUIR PROJECT *of* EARTH ISLAND INSTITUTE

15 June 2013

Re: USFS R5 Draft Bio-Regional Assessment

To Whom It May Concern:

The Center for Biological Diversity and the John Muir Project offer the following comments regarding the Draft Bio-regional Assessment. We also will be providing comments for the NRVs that the Forest Service has produced and will do so by July 15, 2013.

While we appreciate the opportunity to be part of the overall conversation, we are concerned about the manner in which the conversation is happening. First, there appears to be only one narrative that the Forest Service is willing to present – one in which high-severity fire is demonized and used as a scapegoat. As a result, rather than present a nuanced approach to a complex situation, the Forest Service time and again presents a generic condemnation, and fear, of high-severity fire.

Second, and along the same lines, the Forest Service leaves out citations that do not support their particular narrative regarding fire in the Sierra and southern Cascades. We do not expect the Forest Service to adopt our particular view of the fire science any time soon, but we do expect, in the interests of scientific integrity, and informed decision-making, that the Forest Service acknowledge that there is much they do not know, that there exists extensive literature that does not support their narrative, and that the issues are far more complex and nuanced than is expressed in the Bio-regional Assessment. The public can only consider that which it is presented, and if all the public is ever told is that high-severity fire is a problem and out of control, then that is all the public is likely to ever think. It appears to us that the Forest Service is not interested in a conversation about the substantive scientific issues, and that it is only interested in dictating particular outcomes. Again, we do not expect anyone at PSW to support our positions, but our positions are well based in the literature, and therefore, even if PSW disagrees with them, they still have an obligation to present them, and to allow the public to learn the entire story.

Third, the Assessment states that "the writers reviewed the available scientific information and determined which is the most accurate, reliable, and relevant information for the issue." That is not right to do. Such an approach allows the Forest Service to pick and choose which science it wishes to present to the public. The Forest Service knows very well that the vast majority of the public does not read the scientific journals that cover fire issues, and therefore the public only sees what the Forest Service presents. And if the Forest Service only presents one narrative, then that's all the public will ever absorb. It is incumbent upon a public agency to present all the information, not just the information that it subjectively chooses as "the most accurate, reliable, and relevant information for the issue." We therefore request that as we go forward that this approach – allowing the Forest Service writers to "review the available scientific information and determine which is the most accurate, reliable, and relevant information for the issue" – be rejected.

We hope that the Forest Service will revise the Bio-regional Assessment in a way that acknowledges the breadth of the literature and allows the public to thereby learn about and understand the complexities that we all are challenged with resolving.

We turn now to specific issues by providing quotes from the draft Bio-regional Assessment and then addressing them:

- "This landscape was much more diverse, patchy and varied in the past. Now it is much more uniform and dense, and more vulnerable to insects, drought, high severity fire, mortality of trees, and habitat loss.'

  This statement is interesting because we too believe that the landscape was once much more diverse, patchy, and varied. But this is why fires like the McNally Fire, Chips Fire, and Reading Fire are so important—they bring back that very thing by creating a mosaic of burn severities and habitat.

- "Fire is one of the most pressing and recurring issues in the bio-region and western United States. There are two related wildland fire issues in the bio-region, and in much of the drier portions of the west. First, there is a trend of larger, high intensity fires, with greater amounts of high severity effects that threaten ecosystems, homes and economies than in past decades."

  This trend does not actually exist in the bio-region. Hanson and Odion (in press, 2013) conducted the first comprehensive assessment of fire intensity since 1984 in the Sierra Nevada using 100% of available fire intensity data, and, using Mann-Kendall trend tests (a common approach for environmental time series data—one which has similar or greater statistical power than parametric analyses when using non-parametric data sets, such as fire data). They found no increasing trend in terms of high-intensity fire proportion, area, mean patch size, or maximum patch size. Hanson and Odion (in press, 2013) checked for serial autocorrelation in the data, and found none, and used pre-1984 vegetation data (1977 Cal Veg) in order to completely include any conifer forest experiencing high-intensity fire in all time periods since 1984 (the accuracy of this data at the forest strata scale used in the analysis was 85-88%). Hanson and Odion (in press, 2013) also checked the results of Miller et al. (2009) and Miller and Safford (2012) for bias, due to the use of vegetation layers that post-date the fires being analyzed in those studies. Hanson and Odion (in press, 2013) found that there is a statistically significant bias in both studies ($p = 0.025$ and $p = 0.021$, respectively), the effect of which is to exclude relatively more conifer forest experiencing high-intensity fire in the earlier years of the time series, thus creating the false appearance of an increasing trend in fire severity. Also, Miller et al. (2012a), acknowledged the potential bias that can result from using a vegetation classification data set that post-dates the time series. In that study, conducted in the Klamath region of California, Miller et al. used a vegetation layer that preceded the time series, and found no trend of increasing fire severity. Miller et al. (2009) and Miller and Safford (2012) did not, however, follow this same approach. Hanson and Odion (in press, 2013) also found that the regional fire severity data set used by Miller et al. (2009) and Miller and Safford (2012) disproportionately excluded fires in the earlier years of the time series, relative to the standard national fire severity data set (www.mtbs.gov) used in other fire severity trend studies, resulting in an additional bias which created, once again, the inaccurate appearance of relatively less high-severity fire in the earlier years, and relatively more in more recent years. The results of Hanson and Odion (in press, 2013) are consistent with all other recent studies of fire severity trends in California's forests that have used all available fire intensity data, including Collins et al. (2009) in a portion of Yosemite National Park, Schwind (2008) regarding all vegetation in California, Hanson et al. (2009) and Miller et al. (2012a) regarding conifer forests in the Klamath and southern Cascades regions of California, and Dillon et al. (2011) regarding forests of the Pacific (south to the northernmost portion of California) and Northwest.

- "These fires are increasingly outside the range of variation of the historic fire regimes for most ecosystems."

  No basis is provided for this statement; regardless, the most current fires, such as the Chips fire, the Reading fire, and the Barry Point fire, have all burned at predominantly low-moderate severity. Likewise, one of the most recent "large" fires in the southern Sierra, the McNally, also burned at predominantly low-moderate severity. Moreover, the draft Bio-regional Assessment fails to meaningfully acknowledge what wildlife biology tells us about the importance of recent fires that contained patches of high-severity fire. For example, while some recent fires have been characterized as too large or as containing too high a percentage of high-severity fire (e.g., McNally Fire, Moonlight Fire), these same fires can be characterized as ecologically beneficial (and necessary from an evolutionary perspective) in light of data regarding wildlife use of the post-fire landscape. In regard to the McNally Fire, one study (Buchalski et al. 2013) found that most phonic groups of bats showed higher activity in areas burned with moderate to high-severity. (*See also* Malison and Baxter 2010, finding greater bat activity was observed in high-severity burned riparian habitat within mixed-confer forest than at unburned areas of similar habitat in central Idaho). Similarly, in the McNally area, California spotted owls were found to be preferentially selecting high-severity fire areas for foraging (Bond et al. 2009). And most recently, Hanson (in preparation, 2013), using scat-detecting dogs in burned (not salvage logged) and unburned areas of the northern Kern Plateau, is finding that: a) fishers select mature/old forest both when it is unburned and when it has experienced moderate/high-severity wildland fire; b) when near fire edges, fishers select the within-fire side of fire boundaries, rather than avoid fires; and c) fishers are using large mixed-severity fire areas (e.g., McNally fire of 2002) over 5-6 kilometers inside the fire (i.e., over 5-6 km from the nearest edge of the fire perimeter). While these data are as yet unpublished, they are the only data available that actually examine how fishers use a post-fire landscape and demonstrate that the Forest Service's categorical assumptions about high-severity fire effects on fisher are off-base.

  In the Moonlight Fire area, researchers explained that "[i]t is clear from our first year of monitoring three burned areas [Cub, Moonlight and Storrie Fires] that post-fire habitat, especially high severity areas, are an important component of the Sierra Nevada ecosystem." (Burnett et al. 2010). They also found that "[o]nce the amount of the plot that was high severity was over 60% the density of cavity nests increased substantially," and that "more total species were detected in the Moonlight fire which covers a much smaller geographic area and had far fewer sampling locations than the [unburned] green forest." (Burnett et al. 2010). Moreover, while the Forest Service has characterized the Moonlight Fire as detrimental to spotted owls, the impacts of the extensive salvage logging on private lands directly adjacent to the PACs were not accounted for. In general as well, it is important to keep in mind that post-fire areas that are manipulated by salvage logging and/or by reforestation efforts are, from an ecological perspective, no longer valuable as post-fire areas; rather, post-fire salvage logging and reforestation substantially reduce, and often locally eliminate, wildlife species strongly associated with the forest habitat created by high-severity fire patches (Hanson and North 2008, Hutto 2008, Burnett et al. 2011, 2012, Seavy et al. 2012, Siegel et al. 2012, 2013).

Time since fire provides important insights into the continuum of use of post-fire areas over time by different species. Black-backed woodpeckers, for example, are well known to require areas with very high snag densities immediately post-fire – e.g., mature forest that has very recently experienced higher-severity fire, and has not been salvage logged (Hanson and North 2008, Hutto 2008, Saab et al. 2009, Seavy et al. 2012, Siegel et al. 2010, 2011, 2012, 2013). However, "while some snag associated species (e.g. black-backed woodpecker) decline five or six years after a fire [and move on to find more recent fire areas], [species] associated with understory plant communities take [the woodpeckers'] place resulting in similar avian diversity three and eleven years after fire (e.g. Moonlight and Storrie)." (Burnett et al. 2012). Burnett et al. (2012) also noted that "there is a five year lag before dense shrub habitats form that maximize densities of species such as Fox Sparrow, Dusky Flycatcher, and MacGillivray's Warbler. These species have shown substantial increases in abundance in the Moonlight fire each year since 2009 but shrub nesting species are still more abundant in the eleven year post-burn Storrie fire. This suggests early successional shrub habitats in burned areas provide high quality habitat for shrub dependent species well beyond a decade after fire." (Burnett et al. 2012). Raphael et al. (1987) found that at 25 years after high-severity fire, total bird abundance was slightly higher in snag forest than in unburned old forest in eastside mixed-conifer forest of the northern Sierra Nevada; and bird species richness was 40% higher in snag forest habitat. In earlier post-fire years, woodpeckers were more abundant in snag forest, but were similar to unburned by 25 years post-fire, while flycatchers and species associated with shrubs continued to increase to 25 years post-fire (Raphael et al. 1987). In ponderosa pine and Douglas-fir forests of Idaho at 5-10 years post-fire, levels of aquatic insects emerging from streams were two and a half times greater in high-severity fire areas than in unburned mature/old forest, and bats were nearly 5 times more abundant in riparian areas with high-severity fire than in unburned mature/old forest (Malison and Baxter 2010). Schieck and Song (2006) found that bird species richness increased up to 30 years after high-severity fire, then decreased in mid-successional forest [31-75 years old], and increased again in late-successional forest [>75 years]).

Even areas that burn at high-severity and then, shortly therafter, burn again at high-severity, are ecologically valuable. Donato et al. (2009) found that a high-severity re-burn [high-severity fire occurring 15 years after a previous high-severity fire] had the highest plant species richness and total plant cover, relative to high-severity fire alone [no re-burn] and unburned mature/old forest; and the high-severity fire re-burn area had over 1,000 seedlings/saplings per hectare of natural conifer regeneration. Fontaine et al. (2009) found that bird species richness was not significantly different between high-severity re-burn, high-severity burn alone, and unburned old-growth forest, but was numerically highest in areas burned once by high-severity fire 17-18 years earlier, and in high-severity re-burn areas. Total bird abundance was higher in the high-severity fire area, at 17-18 years post-fire, than in the unburned old-growth forest [Figs. 3a and 3b] (Fontaine et al. 2009).

- "Second, there is a significant absence of low and moderate severity fire, in these strongly fire adapted forests of the Sierra Nevada."

  This is true. But it is also true that there is a significant absence of high severity fire. As found in Odion and Hanson (2013), high-severity fire has declined by sixfold since the early 20th century in the Sierra Nevada and eastern Oregon Cascades due to fire suppression. Further, the current rate of high-severity fire in mature/old forest in the Sierra Nevada and eastern Oregon Cascades is so low, and recent high-severity fire in mature/old forest comprises such a tiny percentage of the overall forested landscape currently (0.66%, or about 1/150th of the landscape), that even if high-severity fire in mature/old forest was increased by several times, it would only amount to a very small proportional reduction in mature/old forest. Further, Hanson and Odion (2013, in press) found that current high-severity fire rotation intervals for the middle/upper-montane forests, and the eastern montane forests, of the Sierra Nevada management region (which includes the southern Cascades of California and the Modoc Plateau) are 893 and 714 years, respectively. These rates are much longer than estimated historical rotation intervals of approximately 165 to 435 years for high-severity fire, based upon multiple studies, indicating a substantial decline in high-severity fire since the early 20th century when fire suppression policies began (Hanson and Odion 2013, in press).

Nor does the Assessment acknowledge that fires like the Chips, Reading, and McNally bring with them not just high severity fire, but even more so, bring with them low and moderate severity fire. Yet the Forest Service portrays such fires as "bad" when in fact such fires are doing the heavy lifting of bringing low, moderate, and high severity fire back to the landscape. Those facts are left out of the Assessment. Nor does the Forest Service admit that it is partly to blame for the lack of more low and moderate severity fire on the landscape—it is the Forest Service that suppresses such fires and has focused on mechanical treatments rather than prescribed fire.

- "These two issues are related because suppression of fire has led to significantly less fire than once occurred naturally on a frequent basis (Van de Water and Safford 2011) and as a result, vegetation is denser, more continuous, and more explosive than ever before (Chapter 3, WIKI; Collins and Skinner 2013; Safford 2013b)."

  It is true of course that there is significantly less fire than once occurred naturally. However, to say that vegetation is "more explosive" fails to present the actual story. As we have explained in our comments time and again, research has found that forest areas that have missed the largest number of fire return intervals in California's forests are burning predominantly at low/moderate-severity levels, and are not experiencing higher fire severity than areas that have missed fewer fire return intervals (Miller et al. 2012b, Odion and Hanson 2008, Odion et al. 2010, van Wagtendonk et al. 2012). This is important because it means that missed fire return intervals are not a reliable indicator of how a forest will burn when fire does again enter a given area.

- "There is a trend of increasing fire severity over the past 10 years or more (Miller et al. 2009)."

  As explained above, Hanson and Odion (2013) shows that this is not true and explains what Miller et al. 2009 did not.

- "However, the total acreage burning annually is well below historic levels (Stephens et al. 2007; Miller et al. 2009; North et al, 2012). "

  This is quite true and yet is not made part of the overall discussion. This fact is central to any meaningful fire discussion and yet it is stated and then essentially ignored.

- "Predicted trends are for longer fire seasons, drier and hotter fire conditions, coupled with persistent trends of over-dense and uniform vegetation, all leading to increased trends in extensive high severity fires during the peak fire season (Westerling 2006; Westerling and Bryant 2008; Westerling et al 2011).

The Forest Service's assertions are one-sided in predicting that fire extent and severity will increase in future decades, due to climate change. The Forest Service only cites studies that predict increases in future fire, and high-severity fire, and avoids mention of the many scientific studies that predict decreased future fire activity as a result of climate change (due to warmer/wetter conditions less conducive to fire, as well as to reductions in pyrogenic vegetation). This one-sided representation of data makes impossible a well-informed public. We have already provided detailed and extensive citations to studies that predict reduced future fire activity from climate change, yet none of that is discussed or addressed. While no one can know for sure whether those who predict increased future fire, or those who predict decreased future fire, will be correct, one thing is for certain: any assessment that does not discuss or acknowledge one half of an ongoing scientific debate is simply not accurate, and again, this is unfair to the public who does not know that it is only being told half the story.

- "Today, there is an imbalance of the types and extent of fire. On one hand, there is an ecological "fire deficit" of low and mixed severity fire. On the other hand, there is more high severity fire in large patches in low and mid-elevation ecosystems."

  No basis or citation is provided for this assertion. There is indeed a fire deficit, but the Forest Service implies that there is now too much high severity fire when in fact there is much too little. Odion and Hanson 2013 found that high-severity fire has declined by sixfold since the early 20th century in the Sierra Nevada and eastern Oregon Cascades due to fire suppression. And as we explained in our comments in the living assessment and for the Synthesis, large patches of high-severity fire provide critical habitat for wildlife and were part of the historic fire regime. The Forest Service has offered no meaningful reason to assume that patches are now somehow too big—current fires are instead providing important habitat for post-fire specialists, and even the fisher, as well as spotted owls, species the Forest Service assumes are harmed by high-severity fire, are using post high-severity areas in the McNally fire..

- "Fire is fundamental in shaping the diversity of habitats, species, and vulnerability to natural events such as drought, or insects and pathogens. Generally, if fire and the severity or effects are within the natural range of variability, it supports or drives ecological integrity. But there are uncertainties defining aspects of the natural range of variability of fire, such as the size and frequency of patches of fire of different severities, and the role in critical habitats such as riparian areas. Despite these uncertainties, fire is one of the foremost drivers of ecological integrity of most ecosystems in the bio-region and is important to understand."

  This is the only time that any nuance enters the Assessment. Everywhere else the Forest Service portrays the situation as though it is fact that current fires are outside the NRV.

- "Recurrent fire kept tree and other plant density lower or patchier, so that when dry summer or windy fall conditions occurred, fire swept through with fewer effects (i.e. less large tree kill) than what is seen now."

  This is presented as fact but no basis is provided for it. Current fires are mostly low and moderate severity and there is a deficit of high-severity fire just as there is a deficit of low severity fire. The concern should be about the lack of fire of all types throughout the Sierra region and especially in the central and southern Sierra, where there is currently an extreme dearth of post-fire habitat.

- "It invigorated browse for wildlife (Shaffer and Laudenslayer 2006). It kept levels of insects in acorns low for better deer and bear browse (Lake and Long 2013). It recycled nutrients, fertilizing soils. It created diverse riparian plant communities (Webster and Halpern 2010), dominated by deciduous shrubs and trees that are important for many songbirds, insects, and litter inputs into the stream food webs. Native Americans lived with fire and through traditional ecological management, utilized it for many life-sustaining purposes, such as: enhancing straight growing shrub stems with no insects to make better baskets; improving game forage or plant vigor for food sources; reducing habitat for disease- spreading ticks; and clearing around living areas or travel routes (Anderson 2006; Lake 2013)."

  This is fine, but it fails to also mention all the benefits of high-severity fire. We have submitted extensive science based comments describing this and yet the Forest service has ignored those comments. It is not ok to continue to ignore the science that shows just how good the habitat is that has been created by fires such as the McNally, the Moonlight, the Storrie, the Chips, and the Reading.

  While much of the conservation attention in the Sierra Nevada has focused on iconic conifers like giant sequoia (*Sequoiadendron giganteum*) and old-growth forests generally, complex early seral forests (CESFs) created by stand-replacing fire are underappreciated for their unique biodiversity (see, e.g., Swanson et al. 2010), and, as such, CESFs are not even included as a habitat type in any current vegetation mapping used by the Forest Service (e.g., California Wildlife Habitat Relations). Complex early seral forests occupy sites that occur in time and space between a stand-replacement disturbance and re-establishment of a closed-forest canopy. Young forests, if resulting from purposeful regeneration harvest or from fire salvage harvest, lack the features and characteristics of unmanaged forests naturally regenerating from high-severity fire. CESFs are rich in post-disturbance legacies (e.g., very high snag levels) and post-fire vegetation (e.g., native fire-following shrubs, flowers, natural conifer regeneration) that provide important habitat for countless species and differ from those created by logging (e.g., salvage or pre-fire thinning), which are deficient in biological legacies and many other key ecological attributes (see, e.g., Table 1 in Swanson et al. 2010, Table 1 in Donato et al. 2012). Thus, to distinguish early seral forests from logged early seral, the term "complex" is used in association with early seral produced by natural disturbances.

  In the Sierra Nevada, CESFs provide habitat for dependent species like Black-backed Woodpeckers. Post-fire logging and tree planting destroys that habitat, even when only partial salvage logging occurs. In the fall of 2012, the U.S. Forest Service recognized that there is a significant concern regarding the conservation of the Black-backed Woodpecker population in California and released a Conservation Strategy for this species (Bond et al. 2012). Among the conservation measures were the following: a) identify the areas of the highest densities of the largest snags, and do not salvage log such areas; b) if the Forest Service decides to conduct post-fire logging in a particular area, logging units should not be bigger than 2.5 hectares, or 6.2 acres (page 10, Recommendation 1.3); and c) avoid post-fire logging during nesting season, May 1 through July 31 (page 10, Recommendation 1.5). The Conservation Strategy is not even mentioned in the Draft Bio-regional Assessment.

  Siegel et al. (2013) describe in detail the level of snag basal area associated with suitable Black-backed Woodpecker foraging habitat, concluding that, within the overall home ranges of an individual pair, a threshold of about 20 square meters/hectare of snag basal area (i.e., over 87 square feet/acre), or at least 17 square meters/hectare (at least 74 square feet/acre), represents suitable, viable foraging habitat for this species (Siegel et al. 2013, pp. 45, 68-70). Siegel et al.

(2013) also found (p. 59) that Black-backed Woodpecker suitable nesting habitat averages 43 square meters/hectare of recent snag basal area, and ranges from 18 to 85 square meters/hectare.

Siegel et al. (2011) concluded that native fire-following shrubs are vitally important to biodiversity in complex early seral forest (CESF) created by high-intensity fire: "Many more species occur at high burn severity sites starting several years post-fire, however, and these include the majority of ground and shrub nesters as well as many cavity nesters. Secondary cavity nesters, such as swallows, bluebirds, and wrens, are particularly associated with severe burns, but only after nest cavities have been created, presumably by the pioneering cavity-excavating species such as the Black-backed Woodpecker. Consequently, fires that create preferred conditions for Black-backed Woodpeckers in the early post-fire years will likely result in increased nesting sites for secondary cavity nesters in successive years."

In addition, the following are some key studies regarding how post-fire logging/artificial-planting can harm wildlife—studies which should be discussed in order to meaningfully inform the public regarding the severe ecological impacts of post-fire logging and replanting: Hanson and North (2008); Hutto (2008); Burnett et al. (2011 [Fig. 11]); and Siegel et al. (2013 [Fig. 13)

- "Very large patches of high severity fire can change ecological function of old forest ecosystems, killing most or all large, old trees across large areas, and breaking connectivity (Franklin and Fites-Kaufman 1996) of canopied forests for cover and travel of wide-ranging species such as the fisher (Zielinski 2013; Keanne 2013)."

  This assumption is not borne out by the use of post-fire habitat that has already been explained above. The very fires that the Forest Service is pointing to as "bad" are the very same fires that researchers are finding to contribute significantly to biodiversity and ecosystem function. The Forest Service should not continue to pretend otherwise. Moreover, as already explained, both fisher and spotted owl are using areas that burned at high-severity.

  The draft Assessment routinely refers to patch size being too large and fire being "uncharacteristic" but without any meaningful context or basis for that characterization – the literature cited for this proposition does not actually establish that any recent wildfires in the Sierras/Cascades are "uncharacteristic." In fact, the only thing "uncharacteristic" is the lack of fire of all severities.

  High-severity fire, as well as large patches of high-severity fire, are an important component of not only fir and lodgepole pine forest, but also of mixed-conifer forests in the Sierra/Cascade region, and the available literature indicates that a wide range of high-severity fire (extent as well as patch size) is ecologically appropriate and acceptable (e.g., Beaty and Taylor 2001, Bekker and Taylor 2001, Bekker and Taylor 2010, Collins and Stephens 2010).

  Contrary to assumptions (e.g., the 2004 Sierra Nevada Framework), considerable data and research exists that indicates that mixed-severity fire: a) is not limited to true fir and lodgepole pine and is instead also a natural condition in ponderosa-pine/Jeffrey-pine and mixed-conifer forest; b) generally dominated pre-fire suppression fire regimes in these forest types; and c) can include a significant proportion of high-severity fire including occasional large high-severity fire patches hundreds or thousands of acres in size (Baker 2006, Baker 2012, Baker et al. 2007, Beaty and Taylor 2001, Bekker and Taylor 2001, Bekker and Taylor 2010, Brown et al. 1999, Collins and Stephens 2010, Colombaroli and Gavin 2010, Hessburg et al. 2007, Iniguez et al. 2009, Klenner et al. 2008, Leiberg 1897, 1899a, 1899b, 1899c, 1900a, 1900b, 1900c, 1902, 1903, 1904a, 1904b, Nagel and Taylor 2005, Sherriff and Veblen 2007, Shinneman and Baker 1997, Show and Kotok, 1924, 1925, Stephenson et al. 1991, Taylor 2002, USFS 1910-1912, Whitlock et al. 2008, 2010, Williams and Baker 2010, 2011, 2012a, 2012b, Wills and Stuart 1994).

Beaty and Taylor (2001), in the western slope of the southern Cascades in California, found that historic fire severity in mixed-conifer forests was predominantly moderate- and high-severity, except in mesic canyon bottoms, where moderate- and high-severity fire comprised 40.4% of fire effects [Table 7]. Bekker and Taylor (2001), another study in the western slope of the southern Cascades in California, found historic fire severity to be predominantly high-severity in their study area [Fig. 2F]. Bekker and Taylor (2010), in mixed-conifer forests of the southern Cascades, found reconstructed fire severity to be dominated by high-severity fire effects, including high-severity fire patches over 2,000 acres in size [Tables I and II].

Outside of the Cascades, Leiberg (1902), which contains information from the central and northern Sierra Nevada, found high-severity fire patches over 5,000 acres in size in mixed-conifer forest that had not been logged previously during the 19th century, prior to fire suppression. Show and Kotok (1924), in ponderosa pine and mixed-conifer/pine forests of the Sierra Nevada, found that high-severity crown fires, though infrequent on any particular area, “may extend over a few hundred acres” in patches [p. 31; see also Plate V, Fig. 2, Plate VII, Fig. 2, Plate VIII, Plate IX, Figs. 1 and 2, and Plate X, Fig. 1], with some early-successional areas resulting from high-severity fire patches covering 5,000 acres in size or more [pp. 42-43]. Within unlogged areas, the authors noted many large early-successional habitat patches, dominated by montane chaparral and young, regenerating conifer forest, and explained that such areas were the result of past severe fire because: a) patches of mature/old forest and individual surviving trees were found interspersed within these areas, and were found adjacent to these areas, indicating past forest; b) snags and stumps of fallen snags, as well as downed logs from fallen snags, were abundant in these areas; c) the species of chaparral found growing in these areas are known to sprout abundantly following severe fire; and d) natural conifer regeneration was found on most of the area [p. 42], often growing through complete chaparral cover [p. 43]. Similarly, Show and Kotok (1925) found that within the ponderosa pine and mixed-conifer/pine belt of the Sierra Nevada, 1 acre out of every 7 on average was dominated by montane chaparral and young regenerating conifer forest following high-severity fire [Footnote 2, and Figs. 4 and 5]; and on one national forest 215,000 acres out of 660,000 was early-successional habitat from severe fire [p. 17]. Forest Service Timber Survey Field Notes from 1910-1912 show that surveys were conducted within primary forest to evaluate timber production potential in 16.2-ha (40-acre) plots within each 259.1-ha (640-acre) section in ponderosa pine and mixed-conifer forest on the westside of the Stanislaus National Forest, using one or more 1.62-ha transect per plot. The surveyors noted that surveys for individual tree size, density and species were not conducted in areas that had experienced high-severity fire sufficiently recently such that the regenerating areas did not yet contain significant merchantable sawtimber. Surveyors also noted that the dominant vegetation cover across the majority of many 259.1-ha sections was montane chaparral and young conifer regeneration following high-severity fire. For example (from a typical township in the data set): a) T1S, R18E, Section 9 (“Severe fire went through [this section] years ago and killed most of the trees and land was reverted to brush”, noting “several large dense sapling stands” and noting that merchantable timber existed on only four of sixteen 16.2-ha plots in the section); b) T1S, R18E, Section 14 (“Fires have killed most of timber and most of section has reverted to brush”); c) T1S, R18E, Section 15 (same); d) T1S, R18E, Section 23 (“Most of timber on section has been killed by fires which occurred many years ago”); T1S, R18E, Section 21 (“Old fires killed most of timber on this section and most of area is now brushland”.)

Existing data and research also suggest that Sierra forests were historically structurally complex, with a high degree of heterogeneity from natural disturbance, in terms of chaparral patch extent, stand structure, density, and species composition—including stands dominated by fir and cedar with dense understories as a significant part of the mix in both ponderosa-pine/Jeffrey-pine and mixed-conifer forests. Baker (2012) found that historic mixed-conifer forests contained some open and park-like areas, but such areas were a minority. Rather, overall, the area was dominated by denser forests with substantial shrub cover and understory conifer density—small trees comprised over 50% of all trees on over 72% of the forest (see also Duren et al. 2012.) Leiberg (1902) found that, in mixed-conifer forests in the central and northern Sierra Nevada, while some of the areas were open and parklike stands dominated by ponderosa pine, Jeffrey pine, and sugar pine, the majority were dominated by white fir, incense-cedar, and Douglas-fir, especially on north-facing slopes and on lower slopes of subwatersheds; such areas were predominantly described as dense, often with "heavy underbrush" from past mixed-severity fire. Natural heterogeneity, resulting from fire, often involved dense stands of old forest adjacent to snag forest patches of standing fire-killed trees and montane chaparral with regenerating young conifers: "All the slopes of Duncan Canyon from its head down show the same marks of fire—dead timber, dense undergrowth, stretches of chaparral, thin lines of trees or small groups rising out of the brush, and heavy blocks of forest surrounded by chaparral." [p. 171] Similarly, the USDA 1910-1912 Timber Survey Field Notes found that historic ponderosa pine and mixed-conifer forests of the central/southern Sierra Nevada [western slope] varied widely in stand density and composition; open and park-like pine-dominated stands comprised a significant portion of the lower montane and foothill zones, but dense stands dominated by fir and cedar, and by small/medium-sized trees, dominated much of the middle montane zone (It should be noted that the old-growth forests chosen for study by Scholl and Taylor 2010 and Collins et al. 2011 comprised only a very small portion of the 1910-1912 Stanislaus data set). Nagel and Taylor (2005) noted that "[c]haparral has been replaced by forest and this vegetation change has reduced the heterogeneity of the mixed conifer forest landscapes in the Sierra Nevada. . . Our study suggests that maintenance of chaparral should be an integral part of ecosystem restoration plans for mixed conifer forest landscapes in the Lake Tahoe basin and northern Sierra Nevada."

Current rates of high-severity fire (rotation intervals) in the Sierra Nevada and southern Cascades are also likely far lower (longer rotation intervals) than historic rates, indicating less high-severity fire and therefore a high-severity fire deficit (e.g., Odion and Hanon 2013). Miller et al. (2012) found that the current high-severity fire rotation interval in the Sierra Nevada management region overall is over 800 years. The authors recommended increasing high-severity fire amounts [i.e., decreasing rotation intervals] in the Cascades-Modoc region and on the western slope of the Sierra Nevada, where the current high-severity fire rotation is 859 to 4650 years [Table 3]. The authors noted that "high-severity rotations may be too long in most Cascade-Modoc and westside NF locations, especially in comparison to Yosemite . . . ."

- "Other species, such as the black-backed woodpecker are drawn to these freshly burned sites with their high prevalence of snags. Other birds increase or are drawn here by the vigorous growth of shrubs or hardwood trees, stimulated to sprout by fire (PRBO 2012).

  This is inadequate. It needs to be made clear that bbwos are not just drawn here, this is the heart of their existence in terms of where they eat, sleep, and reproduce. A recent Ph.D dissertation, (Rota 2013), makes this even more clear as explained below. Moreover, the Forest Service needs to make clear that even small amounts of salvage logging can demean the value of bbwo habitat.

The Black-backed Woodpecker depends upon areas of dense, mature/old, middle/upper-montane conifer forest that has recently (generally within 7 years or so) experienced higher-severity fire (generally 50-100% mortality) and has not been subjected to any significant amount of post-fire salvage logging (Hutto and Gallo 2006, Hanson and North 2008, Hutto 2008, Siegel et al. 2011, Rota 2013, Siegel et al. 2013), relying upon areas with >20 square meters/hectare of recent snag basal area for suitable foraging habitat, and >40 square meters/hectare of snag basal area for nesting habitat (Siegel et al. 2013). These conditions comprise moderate- to high-quality Black-backed Woodpecker habitat. While Black-backed Woodpeckers may be found nesting, and even reproducing, in unburned forests with very high levels of bark beetle mortality, or in lower-severity prescribed burns, and, on rare occasions, in unburned forests with a scattering of dead trees, these areas are deficient in wood-boring beetle larvae (Rota 2013). Black-backed Woodpeckers are highly specialized and adapted to prey upon the large wood-boring beetle larvae found predominantly in recent higher-severity wildland fire areas (as opposed to the much smaller bark beetle larvae generally inhabiting unburned forests and low-severity prescribed burns). Because of this, and because of much higher predation of juveniles and adults from raptors due to the lack of camouflage for Black-backed Woodpeckers in unburned or low-severity fire areas relative to higher-severity fire areas (Black-backed Woodpeckers are remarkably camouflaged against the charred bark of trees killed in crown fires), local Black-backed Woodpecker populations decline steeply in unburned bark-beetle mortality areas or low-severity prescribed burn areas, and the data indicate that they need a steady supply of very recent higher-severity wildland fire areas in dense, mature/old forest to prevent overall population decline (Rota 2013, Siegel et al. 2013). The results of Rota (2013) indicate that unburned beetle-kill forests and low-severity prescribed burn areas do not support viable populations of Black-backed Woodpeckers, but very high snag-density beetle-kill areas do tend to slow the population decline of Black-backed Woodpeckers in between occurrences of higher-severity wildland fire (if prescribed burns were conducted within the natural fire season, and achieved substantial higher-severity fire effects, which almost never occurs currently, Rota's results suggest that this would provide suitable habitat).

- "Songbirds and the black-backed woodpecker use other habitats and it is likely that previous, highly variable, fine-scale patchiness from varying fire was equally used.

  What does this even mean? That bbwos and other bird species don't actually need the habitat that research shows they highly select for? If so, such an assertion lacks any basis in the literature. This statement should be removed as it wrongly gives the impression that certain species do not in fact need the habitat that research shows them to need.

- "The California spotted owl has a more variable and complex response. Some level of predominately low and moderate severity fire may not change reproduction or occupancy of owls, and can increase rodent populations that provide food. It is uncertain how much and what kind of fire has specific effects but large areas of high severity fire remove nesting habitat for long periods until forests can grow and mature."

  This statement fails to present what the literature actually finds regarding spotted owl use of high-severity fire areas (e.g., Bond et al 2009, Lee et al 2012).

- "In order to look at conditions and trends in fire resiliency across the bio-region, two different approaches were applied: fire return interval departure, and fire resiliency index across watersheds. For both, the purpose was to define resilience in terms of sustaining ecological integrity, the primary intent of the new planning rule."

Neither of these approaches provides meaningful information about how areas will actually burn should fire return to them. Another approach would be to focus on fire rotation. At its most basic, fire rotation is "the time required to burn an area equal to the area of interest." Also, while fire rotation is often used to describe stand-replacing fire, it is equally relevant to surface-fire, since in both cases fires burn over a certain land area. Fire rotation interval is the only metric that directly relates to how long it takes for the entire area in question, on average, to burn (once), and therefore can differ significantly from fire return interval (FRI); FRI can often overestimate fire frequency because any time a fire occurs in the area of interest, it is recorded as if the entire area burned, whereas in reality only a fraction of the area may have burned. If the objective is to address the lack of fire on the landscape – which should be the objective – then it would make sense to examine where the fire rotations are the longest relative to what the existing data indicate they would have been historically, on average (generally, for mixed-conifer, this would be areas with fire rotations that are the "farthest" above about 30 years). In general, fire rotation throughout the Sierras is considerably longer that historically, and therefore the Sierra would benefit from actions that put more fire, including mixed-severity fire, on the landscape. Moreover, in Thompson et al. 2009, the authors contrast ecological resilience, which pertains to the maintenance of the full complement of native biodiversity by maintaining active natural disturbance regimes, with *engineering* resilience, which pertains to the suppression of natural disturbance and the habitat structures and complex early-successional habitat created by such disturbance.

- "The number of fires in the bio-region that have been of higher severity than expected in recent years is increasing and this trend is expected to continue. Recent research demonstrates an increased proportion of high-severity fire in yellow pine and mixed-conifer forests in the Sierra Nevada from 1984 to 2010 (Miller et al. 2009, Miller and Safford 2012). These studies demonstrate that fire sizes and annual area burned have also gone up during that period. Notable increases in fire activity are predicted for California. These are driven by projected increases in temperature, and decreases in snow pack. To a lesser extent, they are driven by increased fuel production from CO_2 "fertilization" (Collins and Skinner 2013, Flannigan et al. 2000, Lenihan et al. 2003, Lenihan et al. 2008, Westerling et al. 2011). In addition, as human development continues in the bio-region, the need to protect lives and property continues to increase (CalFire 2010)."

  Again, this is not actually true. Hanson and Odion (in press, 2013) conducted the first comprehensive assessment of fire intensity since 1984 in the Sierra Nevada using 100% of available fire intensity data, and, using Mann-Kendall trend tests (a common approach for environmental time series data—one which has similar or greater statistical power than parametric analyses when using non-parametric data sets, such as fire data). They found no increasing trend in terms of high-intensity fire proportion, area, mean patch size, or maximum patch size. Hanson and Odion (in press, 2013) checked for serial autocorrelation in the data, and found none, and used pre-1984 vegetation data (1977 Cal Veg) in order to completely include any conifer forest experiencing high-intensity fire in all time periods since 1984 (the accuracy of this data at the forest strata scale used in the analysis was 85-88%). Hanson and Odion (in press, 2013) also checked the results of Miller et al. (2009) and Miller and Safford (2012) for bias, due to the use of vegetation layers that post-date the fires being analyzed in those studies. Hanson and Odion (in press, 2013) found that there is a statistically significant bias in both studies ($p = 0.025$ and $p = 0.021$, respectively), the effect of which is to exclude relatively more conifer forest experiencing high-intensity fire in the earlier years of the time series, thus creating the false appearance of an increasing trend in fire severity. Interestingly, Miller et al. (2012a), acknowledged the potential bias that can result from using a vegetation classification data set that post-dates the time series. In that study, conducted in the Klamath region of California, Miller et al. used a vegetation layer that preceded the time series, and found no trend of increasing fire severity. Miller et al. (2009) and Miller and Safford (2012) did not, however, follow this same approach. Hanson and Odion (in press, 2013) also found that the regional fire severity data set used by Miller et al. (2009) and Miller and Safford (2012) disproportionately excluded fires in the earlier years of the time series, relative to the standard national fire severity data set (www.mtbs.gov) used in other fire severity trend studies, resulting in an additional bias which created, once again, the inaccurate appearance of relatively less high-severity fire in the earlier years, and relatively more in more recent years. The results of Hanson and Odion (in press, 2013) are consistent with all other recent studies of fire severity trends in California's forests that have used all available fire intensity data, including Collins et al. (2009) in a portion of Yosemite National Park, Schwind (2008) regarding all vegetation in California, Hanson et al. (2009) and Miller et al. (2012a) regarding conifer forests in the Klamath and southern Cascades regions of California, and Dillon et al. (2011) regarding forests of the Pacific (south to the northernmost portion of California) and Northwest.

- "To get a sense of the extent to which fire threatens the many important services that are provided by our forests in the bio-region, important landscapes that provide these services were examined for their risk for uncharacteristic fire that would be detrimental to these services. It is clear that a high percentage of these important landscapes are under a threat from uncharacteristic fire (Chapter 7, WIKI)."

No meaningful basis is provided for these conclusions as the underlying assumptions about past fire, current fire, and fire return, are not valid.

- "Fires are . . . larger, or more severe than they were pre-settlement."

As has been explained, there is no meaningful basis for this conclusion.

- "large portion of the bio-region, the montane pine and mixed conifer forests, are relatively productive in terms of vegetation growth, but because they are dry, decomposition is slow. … This results in increasing fuels for fire and the likelihood of high intensity crown fires (Stephens et al. 2012) and the likelihood of widespread insect outbreak (Sierra Nevada Conservancy 2012a) beyond natural range of variability levels (Chapter 3, WIKI)."

These studies do not actually establish what the Forest Service purports them to establish.

- "Large, high intensity fires threaten to set back large areas of older or mature forest to early seral, fragmenting habitat in one year. Similarly, California spotted owl and goshawk are threatened by large, high severity fires."

This statement in relation to fishers and spotted owls find no basis in literature that has actually examined fisher or owl use of post-fire landscapes. Hanson (in preparation, 2013), using scat-detecting dogs in burned (not salvage logged) and unburned areas of the northern Kern Plateau, is finding that: a) fishers select mature/old forest both when it is unburned and when it has experienced moderate/high-severity wildland fire; b) when near fire edges, fishers select the within-fire side of fire boundaries, rather than avoid fires; and c) fishers are using large mixed-severity fire areas (e.g., McNally fire of 2002) over 5-6 kilometers inside the fire (i.e., over 5-6 km from the nearest edge of the fire perimeter). While these data are as yet unpublished, they are the only data available that actually examine how fishers use a post-fire landscape.

Moreover, the spotted owl literature shows them to be using high-severity areas.

- "Gradual, but steady population declines of California spotted owl over the past 20 years have been observed (Keane 2013). Although the distribution of the spotted owl is still intact, there have been concerns raised since 1992 about areas where there are low numbers of owls, high fragmentation from past, large, high intensity fires, or mixed ownership with less certainty of owl habitat management. These were called "areas of concern" in a comprehensive scientific report in 1992 (Verner et al. 1992)."

  It is necessary to address that recent science shows high-severity fires patches to be useful to owls and that many areas were salvaged logged thus eliminating or heavily demeaning post-fire owl habitat.

- "There has been a disproportionately high concentration of owl nest sites impacted by high severity fire in the north in the past decade, primarily from several large fires that burned under very hot, dry and often windy conditions in steep terrain. Some birds respond favorably to these fires; however, many distributed, smaller large severity patches would provide better connectivity across the bio-region, than several large, high severity patches in limited areas. A few high severity fires do not contribute as much to connectivity for early seral species, and are detrimental to connectivity for late seral forest species."

  This assertion misses the point that more high-severity fire, as well as more low and moderate severity fire, is needed across the landscape. Odion and Hanson 2013, for example, explain that the current rate of high-severity fire in mature/old forest in the Sierra Nevada and eastern Oregon Cascades is so low, and recent high-severity fire in mature/old forest comprises such a tiny percentage of the overall forested landscape currently (0.66%, or about 1/150th of the landscape), that even if high-severity fire in mature/old forest was increased by several times, it would only amount to a very small proportional reduction in mature/old forest, while getting Black-backed Woodpecker habitat closer to its historical, natural levels.

- "On the other hand, the trend is for larger patches of uniform, early aged, or early seral vegetation to develop after fire. This can be good for the plants and animals in these habitats. The patches are often very large, however, compared to historic patterns, and are widely distributed, limiting movement of species between them, or "connectivity".

  This claim finds no meaningful basis in the literature and simply reflects the Forest Service's worldview as to fire.

- "Wildland fires are becoming larger, more frequent and of greater severity, which will lead to reductions in ecosystem benefits."

  This is egregiously untrue as explained above.

- "Nearly half of the Critical Aquatic Refuges (CARS), 2/3 of the goshawk and fisher locations, and more than 80% of the spotted owl and pine marten sites are in landscapes with low to very low fire resilience. It is clear that a high percentage of important landscapes are under a threat from uncharacteristic fire."

  This should instead state that a high percentage of the Sierra is under threat from a lack of fire, including a lack of high-severity fire.

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Burnett, R.D., P. Taillie, and N. Seavy. 2011. Plumas Lassen Study 2010 Annual Report. U.S. Forest Service, Pacific Southwest Region, Vallejo, CA. ***(Black-backed Woodpecker nesting was eliminated by post-fire salvage. See Figure 11 [showing nest density on national***

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Haire, S.L. and K. McGarigal. 2010. Effects of landscape patterns of fire severity on regenerating ponderosa pine forests (*Pinus ponderosa*) in New Mexico and Arizona, USA. Landscape Ecology 25: 1055-1069. ***(Natural post-fire conifer regeneration, within the same fire areas analyzed in Haire and McGarigal 2008, occurs in 100% mortality patches even 200 or more meters from the nearest live tree, and regeneration nearer to the live-tree edge occurs vigorously within a few years post-fire, increasing rapidly after 10-15 years post-fire [Fig. 5]. The proportion of the total high-severity fire area that is more than 200 meters from the nearest live-tree edge was relatively small [Fig.2].)***

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Haney, A., S. Apfelbaum, and J.M. Burris. 2008. Thirty years of post-fire succession in a southern boreal forest bird community. The American Midland Naturalist 159: 421-433. ***(By 30 years after high-severity fire, bird species richness increased 56% relative to pre-fire mature unburned forest.)***

Hanson, C. T. and M. P. North. 2008. Postfire woodpecker foraging in salvage-logged and unlogged forests of the Sierra Nevada. Condor 110: 777–782. ***(Black-backed woodpeckers depend upon dense, mature/old forest that has recently experienced higher-severity fire, and has not been salvage logged; sBlack-backed Woodpeckers selected dense, old forests that experienced high-severity fire, and avoided salvage logged areas [see Tables 1 and 2].)***

Hanson, C.T. , D.C. Odion, D.A. DellaSala, and W.L. Baker. 2009. Overestimation of fire risk in the Northern Spotted Owl Recovery Plan. Conservation Biology 23:1314–1319. ***(Fire severity is not increasing in forests of the Klamath and southern Cascades or eastern Cascades.)***

Hanson, C.T., D.C. Odion, D.A. DellaSala, and W.L. Baker. 2010. More-comprehensive recovery actions for Northern Spotted Owls in dry forests: Reply to Spies et al. Conservation Biology 24:334–337.

Hanson, C.T., and D.C. Odion. 2013. Is fire severity increasing in the Sierra Nevada mountains, California, USA? *In press* in International Journal of Wildland Fire.

Hessburg, P. F., R. B. Salter, and K. M. James. 2007. Re-examining fire severity relations in pre-management era mixed conifer forests: inferences from landscape patterns of forest structure. Landscape Ecology 22:5-24.

Hutto, R. L. 1995. Composition of bird communities following stand-replacement fires in Northern Rocky Mountain (U.S.A.) conifer forests. Conservation Biology 9: 1041–1058.

Hutto, R. L. 2008. The ecological importance of severe wildfires: Some like it hot. Ecological Applications 18:1827–1834. ***(Figure 4a, showing about 50% loss of Black-backed Woodpecker post-fire occupancy due to moderate pre-fire logging [consistent with mechanical thinning] in areas that later experienced wildland fire.)***

Iniguez, J. M., T. W. Swetnam, and C. H. Baisan. 2009. Spatially and temporally variable fire regime on Rincon Mountain, Arizona, USA. Fire Ecology 5:3-21.

Klenner, W., R. Walton, A. Arsenault, L. Kremsater. 2008. Dry forests in the Southern Interior of British Columbia: Historical disturbances and implications for restoration and management. Forest Ecology and Management 256: 1711-1722.

Kotliar, N.B., S.J. Hejl, R.L. Hutto, V.A. Saab, C.P. Melcher, and M.E. McFadzen. 2002. Effects of fire and post-fire salvage logging on avian communities in conifer-dominated forests of the western United States. Studies in Avian Biology 25: 49-64.

Krawchuk, M.A., M.A. Moritz, M. Parisien, J. Van Dorn, and K. Hayhoe. 2009. Global pyrogeography: the current and future distribution of wildfire. PloS ONE 4: e5102. ***(Fire is projected to decrease in the Sierra Nevada management region over the next several decades due to climate change [Fig. 3].)***

Lee, D.E., M.L. Bond, and R.B. Siegel. 2012. Dynamics of breeding-season site occupancy of the California spotted owl in burned forests. The Condor 114: 792-802. ***(Mixed-severity wildland fire, averaging 32% high-severity fire effects, did not decrease California spotted owl territory occupancy, but post-fire salvage logging appeared to adversely affect occupancy.)***

Leiberg, J.B. 1897. General report on a botanical survey of the Coeur d'Alene Mountains in Idaho during the summer of 1895. United States Division of Botany, Contributions from the U.S. National Herbarium Volume V, No. 1, pp. 41–85. US Government Printing Office, Washington, DC.

Leiberg, J.B. 1899a. Bitterroot Forest Reserve. USDI Geological Survey, Nineteenth Annual Report, Part V. Forest Reserves, pp. 253–282. US Government Printing Office, Washington, D.C.

Leiberg, J.B. 1899b. Present condition of the forested areas in northern Idaho outside the limits of the Priest River Forest Reserve and north of the Clearwater River. USDI Geological Survey, Nineteenth Annual Report, Part V. Forest Reserves, pp. 373–386. US Government Printing Office, Washington, DC.

Leiberg, J.B. 1899c. Priest River Forest Reserve. USDI Geological Survey, Nineteenth Annual Report, Part V. Forest Reserves, pp. 217–252. US Government Printing Office, Washington, DC.

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Leiberg, J.B. 1900b. Sandpoint quadrangle, Idaho. USDI Geological Survey, Twenty-first Annual Report, Part V. Forest Reserves, pp. 583–595. US Government Printing Office, Washington, DC.

Leiberg, J. B. 1900c. Cascade Range Forest Reserve, Oregon, from township 28 south to township 37 south, inclusive; together with the Ashland Forest Reserve and adjacent forest regions from township 28 south to township 41 south, inclusive, and from range 2 west to range 14 east, Willamette Meridian, inclusive. U.S. Geological Survey Annual Report 21(V):209-498.

Leiberg, J. B. 1902. Forest conditions in the northern Sierra Nevada, California. USDI Geological Survey, Professional Paper No. 8. U.S. Government Printing Office, Washington, D.C. ***(High-severity fire patches over 5,000 acres in size mapped in mixed-conifer forest that had not been logged previously during the 19^th^ century, prior to fire suppression. In the 19^th^ century, prior to fire suppression, composition of mixed-conifer forests in the central and northern Sierra Nevada was quantified in unlogged areas for several watersheds, and in dozens of specific locations within watersheds. The study reported that, while some of these areas were open and parklike stands dominated by ponderosa pine, Jeffrey pine, and sugar pine, the majority were dominated by white fir, incense-cedar, and Douglas-fir, especially on north-facing slopes and on lower slopes of subwatersheds; such areas were predominantly described as dense, often with "heavy underbrush" from past mixed-severity fire. Natural heterogeneity, resulting from fire, often involved dense stands of old forest adjacent to snag forest patches of standing fire-killed trees and montane chaparral with regenerating young conifers: "All the slopes of Duncan Canyon from its head down show the same marks of fire—dead timber, dense undergrowth, stretches of chaparral, thin lines of trees or small groups rising out of the brush, and heavy blocks of forest surrounded by chaparral." [p. 171])***

Leiberg, J. B. 1903. Southern part of Cascade Range Forest Reserve. Pages 229–289 in H. D. Langille, F. G. Plummer, A. Dodwell, T. F. Rixon, and J. B. Leiberg, editors. Forest conditions in the Cascade Range Forest Reserve, Oregon. Professional Paper No. 9. U.S. Geological Survey, U.S. Government Printing Office, Washington, D.C., USA.

Leiberg, J.B. 1904a. Forest conditions in the Absaroka division of the Yellowstone Forest Reserve, Montana. USDI Geological Survey Professional Paper No. 29, US Government Printing Office, Washington, DC.

Leiberg, J.B. 1904b. Forest conditions in the Little Belt Mountains Forest Reserve, Montana, and the Little Belt Mountains quadrangle. USDI Geological Survey Professional Paper No. 30, US Government Printing Office, Washington, DC.

Lenihan, J.M., D. Bachelet, R.P. Neilson, and R. Drapek. 2008. Response of vegetation distribution, ecosystem productivity, and fire to climate change scenarios for California. Climatic Change 87:S215-S230.

Liu, Y., J. Stanturf, and S. Goodrick. 2010. Trends in global wildfire potential in a changing climate. Forest Ecology and Management 259:685-697. ***(A decrease in fire is projected in California's forested regions over the 21st century due to climate change [Fig. 1].)***

Malison, R.L., and C.V. Baxter. 2010. The fire pulse: wildfire stimulates flux of aquatic prey to terrestrial habitats driving increases in riparian consumers. Canadian Journal of Fisheries and Aquatic Sciences 67: 570-579. ***(In ponderosa pine and Douglas-fir forests of Idaho at 5-10 years post-fire, levels of aquatic insects emerging from streams were two and a half times greater in high-severity fire areas than in unburned mature/old forest, and bats were nearly 5 times more abundant in riparian areas with high-severity fire than in unburned mature/old forest.)***

McKenzie, et al. 2004. Z. Gedalof, D.L. Peterson, and P. Mote. 2004. Climatic change, wildfire, and conservation. Conservation Biology 18: 890-902. *(**Fire was projected to decrease in California's forests in the coming decades from climate change, despite warming, due to increasing summer precipitation**.)*

Miller, J.D., B.M. Collins, J.A. Lutz, S.L. Stephens, J.W. van Wagtendonk, and D.A. Yasuda. 2012b. Differences in wildfires among ecoregions and land management agencies in the Sierra Nevada region, California, USA. Ecosphere 3: Article 80. ***(Current high-severity fire rotation interval in the Sierra Nevada management region overall is over 800 years. The authors recommended increasing high-severity fire amounts [i.e., decreasing rotation intervals] in the Cascades-Modoc region and on the western slope of the Sierra Nevada, where the current high-severity fire rotation is 859 to 4650 years [Table 3]. The authors noted that "high-severity rotations may be too long in most Cascade-Modoc and westside NF locations, especially in comparison to Yosemite…").***

Miller, J.D., C.N. Skinner, H.D. Safford, E.E. Knapp, and C.M. Ramirez. 2012a. Trends and causes of severity, size, and number of fires in northwestern California, USA. Ecological

Applications 22:184-203. ***(No increase in fire severity was found in the Klamath region of California, which partially overlaps the Sierra Nevada management region.)***

Mote, P.W. 2003. Trends in temperature and precipitation in the Pacific Northwest during the twentieth century. Northwest Science 77:271–282.

Nagel, T.A. and Taylor, A.H. 2005. Fire and persistence of montane chaparral in mixed conifer forest landscapes in the northern Sierra Nevada, Lake Tahoe Basin, California, USA. J. Torrey Bot. Soc.132: 442-457.

Odion, D.C., E.J. Frost, J.R. Strittholt, H. Jiang, D.A. DellaSala, and M.A. Moritz. 2004. Patterns of ire severity and forest conditions in the Klamath Mountains, northwestern California. Conservation Biology 18: 927-936.

Odion, D.C., and C.T. Hanson. 2006. Fire severity in conifer forests of the Sierra Nevada, California. Ecosystems 9: 1177-1189.

Odion, D.C., and C.T. Hanson. 2008. Fire severity in the Sierra Nevada revisited: conclusions robust to further analysis. Ecosystems 11: 12-15.

Odion, D. C., M. A. Moritz, and D. A. DellaSala. 2010. Alternative community states maintained by fire in the Klamath Mountains, USA. Journal of Ecology, doi: 10.1111/j.1365-2745.2009.01597.x.

Odion, D.C., and Hanson, C.T. 2013. Projecting impacts of fire management on a biodiversity indicator in the Sierra Nevada and Cascades, USA: the Black-backed Woodpecker. The Open Forest Science Journal 6: 14-23 (in press). ***(High-severity fire, which creates primary habitat for Black-backed Woodpeckers, has declined by sixfold since the early 20th century in the Sierra Nevada and eastern Oregon Cascades due to fire suppression. Further, the current rate of high-severity fire in mature/old forest (which creates primary, or high suitability, habitat for this species) in the Sierra Nevada and eastern Oregon Cascades is so low, and recent high-severity fire in mature/old forest comprises such a tiny percentage of the overall forested landscape currently (0.66%, or about 1/150th of the landscape), that even if high-severity fire in mature/old forest was increased by several times, it would only amount to a very small proportional reduction in mature/old forest, while getting Black-backed Woodpecker habitat closer to its historical, natural levels. Conversely, the combined effect of a moderate version of current forest management—prefire thinning of 20% of the mature/old forest (in order to enhance fire suppression) over the next two decades, combined with post-fire logging of one-third of the primary Black-backed Woodpecker habitat, would reduce primary Black-backed Woodpecker habitat to an alarmingly low 0.20% (1/500th) of the forested landscape, seriously threatening the viability of Black-backed Woodpecker populations.)***

Raphael, M.G., M.L. Morrison, and M.P. Yoder-Williams. 1987. Breeding bird populations during twenty-five years of postfire succession in the Sierra Nevada. The Condor 89: 614-626. ***(At 25 years after high-severity fire, total bird abundance was slightly higher in snag***

forest than in unburned old forest in eastside mixed-conifer forest of the northern Sierra Nevada; and bird species richness was 40% higher in snag forest habitat. In earlier post-fire years, woodpeckers were more abundant in snag forest, but were similar to unburned by 25 years post-fire, while flycatchers and species associated with shrubs continued to increase to 25 years post-fire.)

Rota, C.T. 2013. Not all forests are disturbed equally: population dynamics and resource selection of Black-backed Woodpeckers in the Black Hills, South Dakota. Ph.D. Dissertation, University of Missouri-Columbia, MO. (***Rota (2013) finds that Black-backed Woodpeckers only maintain stable or increasing populations (i.e., viable populations) in recent wildland fire areas occurring within dense mature/older forest (which have very high densities of large wood-boring beetle larvae due to the very high densities of medium/large fire-killed trees). And, while Black-backeds are occasionally found in unburned forest or prescribed burn areas, unburned "beetle-kill" forests (unburned forest areas with high levels of tree mortality from small pine beetles) and lower-intensity prescribed burns have declining populations of Black-backed Woodpeckers (with the exception of a tiny percentage of beetle-kill areas). The study shows that unburned beetle-kill forests do not support viable populations, but very high snag-density beetle-kill areas tend to slow the population decline of Black-backed Woodpeckers in between occurrences of wildland fire. Population decline rates are alarmingly fast in low-intensity prescribed burn areas, indicating that such areas do not provide suitable habitat. Black-backed Woodpeckers are highly specialized and adapted to prey upon wood-boring beetle larvae found predominantly in recent higher-severity wildland fire areas. Moreover, while Black-backed Woodpeckers are naturally camouflaged against the charred bark of fire-killed trees, they are more conspicuous in unburned forests, or low-severity burned forests, and are much more vulnerable to predation by raptors in such areas. For this reason, even when a Black-backed Woodpecker pair does successfully reproduce in unburned forest or low-severity fire areas, both juveniles and adults have much lower survival rates than in higher-severity wildland fire areas.)***

Russell, W. H., J. McBride, and R. Rowntree. Revegetation after four stand-replacing fires in the Tahoe Basin. Madrono 45: 40-46.

Saab, V.A., R.E. Russell, and J.G. Dudley. 2009. Nest-site selection by cavity-nesting birds in relation to postfire salvage logging. Forest Ecology and Management 257:151–159. ***(Black-backed Woodpeckers select areas with about 325 medium and large snags per hectare [about 132 per acre], and nest-site occupancy potential dropped to near zero when snag density was below about 270 per hectare, or about 109 per acre [see Fig. 2A, showing 270 snags per hectare as the lower boundary of the 95% confidence interval].)***

Seavy, N.E., R.D. Burnett, and P.J. Taille. 2012. Black-backed woodpecker nest-tree preference in burned forests of the Sierra Nevada, California. Wildlife Society Bulletin 36: 722-728. ***(Black-backed Woodpeckers selected sites with an average of 13.3 snags per 11.3-meter radius plot [i.e., 0.1-acre plot], or about 133 snags per acre.)***

Schieck, J., and S.J. Song. 2006. Changes in bird communities throughout succession following fire and harvest in boreal forests of western North America: literature review and meta-analyses. Canadian Journal of Forest Research 36: 1299-1318. ***(Bird species richness increased up to 30 years after high-severity fire, then decreased in mid-successional forest [31-75 years old], and increased again in late-successional forest [>75 years]).***

Schwind, B. compiler. 2008. Monitoring trends in burn severity: report on the Pacific Northwest and Pacific Southwest fires (1984 to 2005). U.S. Geological Survey Center for Earth Resources Observation and Science, Sioux Falls, South Dakota. Available from http://www.mtbs.gov/reports/projectreports.htm (accessed October 2008). ***(No increase in fire severity was found in California, with all vegetation combined.)***

Sestrich, C.M., T.E. McMahon, and M.K. Young. 2011. Influence of fire on native and nonnative salmonid populations and habitat in a western Montana basin. Transactions of the American Fisheries Society 140: 136-146. ***(Native Bull and Cutthroat trout tended to increase with higher fire severity, particularly where debris flows occurred.)***

Shatford, J.P.A., D.E. Hibbs, and K.J. Puettmann. 2007. Conifer regeneration after forest fire in the Klamath-Siskiyous: how much, how soon? Journal of Forestry April/May 2007, pp. 139-146.

Sherriff, R. L., and T. T. Veblen. 2007. A spatially explicit reconstruction of historical fire occurrence in the Ponderosa pine zone of the Colorado Front Range. Ecosystems 9:1342-1347.

Shinneman D.J. and W.L. Baker, 1997. Nonequilibrium dynamics between catastrophic disturbances and old-growth forests in ponderosa pine landscapes of the Black Hills. Conservation Biology11: 1276-1288.

Show, S.B. and Kotok, E.I. 1924. The role of fire in California pine forests. United States Department of Agriculture Bulletin 1294, Washington, D.C. ***(Historically, within ponderosa pine and mixed-conifer/pine forests of the Sierra Nevada, high-severity crown fires, though infrequent on any particular area, "may extend over a few hundred acres" in patches [p. 31; see also Plate V, Fig. 2, Plate VII, Fig. 2, Plate VIII, Plate IX, Figs. 1 and 2, and Plate X, Fig. 1], with some early-successional areas, resulting from high-severity fire patches, covering 5,000 acres in size or more [pp. 42-43]. The authors distinguished high-severity fire patches of this size from more "extensive" patches occurring in the northern Rocky Mountains [p. 31], where high-severity fire patches occasionally reach tens of thousands, or hundreds of thousands, of acres in size, and noted that patches of such enormous size were "almost" unknown in Sierra Nevada ponderosa pine and mixed-conifer forests. Within unlogged areas, the authors noted many large early-successional habitat patches, dominated by montane chaparral and young, regenerating conifer forest, and explained that such areas were the result of past severe fire because: a) patches of mature/old forest and individual surviving trees were found interspersed within these areas, and were found adjacent to these areas, indicating past forest; b) snags and stumps of fallen snags, as well as downed logs from fallen snags, were abundant in these areas; c) the species of chaparral found growing in these areas are known to sprout abundantly***

following severe fire; and d) natural conifer regeneration was found on most of the area [p. 42], often growing through complete chaparral cover [p. 43].)

Show, S.B. and Kotok, E.I. 1925. Fire and the forest (California pine region). United States Department of Agriculture Department Circular 358, Washington, D.C. ***(Historically, within the ponderosa pine and mixed-conifer/pine belt of the Sierra Nevada, 1 acre out of every 7 on average was dominated by montane chaparral and young regenerating conifer forest following high-severity fire [Footnote 2, and Figs. 4 and 5]; on one national forest 215,000 acres out of 660,000 was early-successional habitat from severe fire [p. 17].)***

Siegel, R. B., R. L. Wilkerson, and D. L. Mauer. 2008. Black-backed Woodpecker (*Picoides arcticus*) surveys on Sierra Nevada national forests: 2008 pilot study. The Institute for Bird Populations, Point Reyes, CA.

Siegel, R.B., J.F. Saracco, and R.L. Wilkerson. 2010. Management Indicator Species (MIS) surveys on Sierra Nevada national forests: Black-backed Woodpecker. 2009 Annual Report. The Institute for Bird Populations, Point Reyes, CA.

Siegel, R.B., M.W. Tingley, and R.L. Wilkerson. 2011. Black-backed Woodpecker MIS surveys on Sierra Nevada national forests: 2010 Annual Report. A report in fulfillment of U.S. Forest Service Agreement No. 08-CS-11052005-201, Modification #2; U.S. Forest Service Pacific Southwest Region, Vallejo, CA. ***(Black-backed woodpecker occupancy declines dramatically by 5-7 years post-fire relative to 1-2 years post-fire, and approaches zero by 10 years post-fire [Fig. 15a].)***

Siegel, R.B., M.W. Tingley, R.L. Wilkerson, and M.L. Bond. 2012b. Assessing home range size and habitat needs of Black-backed Woodpeckers in California: 2011 Interim Report. Institute for Bird Populations. A report in fulfillment of U.S. Forest Service Agreement No. 08-CS-11052005-201, Modification 3; U.S. Forest Service, Pacific Southwest Region, Vallejo, CA. ***(See Figure 10, showing almost complete avoidance of salvage logged areas by Black-backed Woodpeckers in a radiotelemetry study in the southern Cascades in California.)***

Siegel, R.B., M.W. Tingley, R.L. Wilkerson, M.L. Bond, and C.A. Howell. 2013. Assessing home range size and habitat needs of Black-backed Woodpeckers in California: Report for the 2011 and 2012 field seasons. Institute for Bird Populations. ***(Black-backed woodpeckers strongly select large patches of higher-severity fire with high densities of medium and large snags, generally at least 100 to 200 hectares (roughly 250 to 500 acres) per pair, and post-fire salvage logging eliminates Black-backed woodpecker foraging habitat [see Fig. 13, showing almost complete avoidance of salvage logged areas]. Suitable foraging habitat was found to have more than 17-20 square meters per hectare of recent snag basal area [pp. 45, 68-70], and suitable nesting habitat was found to average 43 square meters per hectare of recent snag basal area and range from 18 to 85 square meters to hectare [p. 59, Table 13]. Moreover, Appendix 2, Fig. 2 indicates that the Sierra Nevada population of Black-backed Woodpeckers is genetically distinct from the Oregon Cascades population,***

though additional work needs to be conducted to determine just how distinct the two populations are.)

Stephens, S.L., R.E. Martin, and N.E. Clinton. 2007. Prehistoric fire area and emissions from California's forests, woodlands, shrublands, and grasslands. Forest Ecology and Management 251:205–216. ***(Estimated high-severity fire proportion and frequency indicate historic high-severity fire rotation intervals of approximately 250 to 400 years in historic ponderosa pine and mixed-conifer forests in California.)***

Stephenson, N. L.; Parsons, D,J.; Swetnam, T,W. 1991. Proceedings of the Tall Timbers Fire Ecology Conference 17:321-337.

Tarbill, G.L. 2010. Nest site selection and influence of woodpeckers on recovery in a burned forest of the Sierra Nevada. Master's Thesis, California State University, Sacramento. ***(In post-fire eastside pine and mixed-conifer forests of the northern Sierra Nevada, Black-backed woodpeckers strongly selected stands with very high densities of medium and large snags, with well over 200 such snags per hectare on average at nest sites [Table 2], and nesting potential was optimized at 250 or more per hectare, dropping to very low levels below 100 to 200 per hectare [Fig. 5b].)***

Taylor A.H. 2002. Evidence for pre-suppression high-severity fire on mixed conifer forests on the west shore of the Lake Tahoe Basin. Final report. South Lake Tahoe (CA): USDA Forest Service, Lake Tahoe Basin Management Unit.

Thompson, I., B. Mackey, S. McNulty, and A. Mosseler. 2009. Forest resilience, biodiversity, and climate change. United Nations Environment Programme (UNEP), Secretariat of the Convention on Biological Diversity, Montreal, Canada. Technical Series No. 43. 67 pp.

USFS (United States Forest Service). 1910-1912. Timber Survey Field Notes, 1910-1912, U.S. Forest Service, Stanislaus National Forest. Record Number 095-93-045, National Archives and Records Administration—Pacific Region, San Bruno, California, USA. ***(Surveys were conducted within primary forest to evaluate timber production potential in 16.2-ha (40-acre) plots within each 259.1-ha (640-acre) section in ponderosa pine and mixed-conifer forest on the westside of the Stanislaus National Forest, using one or more 1.62-ha transect per plot. Surveyors noted that surveys for individual tree size, density and species were not conducted in areas that had experienced high-severity fire sufficiently recently such that the regenerating areas did not yet contain significant merchantable sawtimber. Surveyors noted that the dominant vegetation cover across the majority of many 259.1-ha sections was montane chaparral and young conifer regeneration following high-severity fire. For example (from a typical township in the data set): a) T1S, R18E, Section 9 ("Severe fire went through [this section] years ago and killed most of the trees and land was reverted to brush", noting "several large dense sapling stands" and noting that merchantable timber existed on only four of sixteen 16.2-ha plots in the section); b) T1S, R18E, Section 14 ("Fires have killed most of timber and most of section has reverted to brush"); c) T1S, R18E, Section 15 (same); d) T1S, R18E, Section 23 ("Most of timber on***

section has been killed by fires which occurred many years ago"); T1S, R18E, Section 21 ("Old fires killed most of timber on this section and most of area is now brushland".)

van Wagtendonk, J.W., K.A. van Wagtendonk, and A.E. Thode. 2012. Factors associated with the severity of intersecting fires in Yosemite National Park, California, USA. Fire Ecology 8: 11-32. ***("The proportion burned in each fire severity class was not significantly associated with fire return interval departure class…[L]ow severity made up the greatest proportion within all three departure classes, while high severity was the least in each departure class (Figure 4).")***

Whitlock, C., J. Marlon, C. Briles, A. Brunelle, C. Long and P. Bartlein, 2008. Long-term relations among fire, fuel, and climate in the north-western US based on lake-sediment studies. International Journal of Wildland Fire17: 72-83.

Whitlock, C., P.E. Higuera, D.B. McWethy, and C.E. Briles. 2010. Paleoecological perspectives on fire ecology: revisiting the fire-regime concept. The Open Ecology Journal 3: 6-23.

Williams, M.A. & Baker, W.L. 2010. Bias and error in using survey records for ponderosa pine landscape restoration. *Journal of Biogeography*37, 707–721.

Williams, M.A. & Baker, W.L. 2011. Testing the accuracy of new methods for reconstructing historical structure of forest landscapes using GLO survey data. *EcologicalMonographs*, 81: 63–88.

Williams, M.A., W.L. Baker. 2012a. Spatially extensive reconstructions show variable-severity fire and heterogeneous structure in historical western United States dry forests. Global Ecology and Biogeography. DOI: 10.1111/j.1466-8238.2011.00750.

Williams, M.A., W.L. Baker. 2012b. Comparison of the higher-severity fire regime in historical (A.D. 1800s) and modern (A.D. 1984-2009) montane forests across 624,156 ha of the Colorado Front Range. Ecosystems DOI 10.1007/s10021-012-9549-8.

Wills, R. D. & Stuart, J. D. 1994. Fire history and stand development of a Douglas-fir/hardwood forest in northern California. Northwest Science68, 205-212.

Sincerely,

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